US009172196B2

(12) **United States Patent**
**Hemmi et al.**

(10) **Patent No.: US 9,172,196 B2**
(45) **Date of Patent: Oct. 27, 2015**

(54) **BRUSH HAVING A PLURALITY OF ELASTIC CONTACT PIECES ARRANGED IN PARALLEL**

(71) Applicant: **OMRON CORPORATION**, Kyoto-shi (JP)

(72) Inventors: **Yoshinobu Hemmi**, Otsu (JP); **Hideaki Ozaki**, Takatsuki (JP); **Hirotada Teranishi**, Osaka (JP)

(73) Assignee: **OMRON Corporation**, Kyoto (JP)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 131 days.

(21) Appl. No.: **13/949,775**

(22) Filed: **Jul. 24, 2013**

(65) **Prior Publication Data**

US 2014/0038435 A1 Feb. 6, 2014

(30) **Foreign Application Priority Data**

Jul. 31, 2012 (JP) ..... 2012-170554

(51) **Int. Cl.**

| | |
|---|---|
| ***H01R 4/48*** | (2006.01) |
| ***H01R 35/02*** | (2006.01) |
| ***H01R 39/18*** | (2006.01) |
| ***H01R 39/24*** | (2006.01) |

(52) **U.S. Cl.**

CPC ..... ***H01R 35/02*** (2013.01); ***H01R 39/18*** (2013.01); ***H01R 39/24*** (2013.01)

(58) **Field of Classification Search**

CPC ..... H01R 39/18; H01R 39/24
USPC ..... 439/857, 862, 81, 22
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

| | | | | |
|---|---|---|---|---|
| 5,296,774 | A * | 3/1994 | Nishiwaki | 310/248 |
| 6,007,344 | A * | 12/1999 | Corrunker et al. | 439/22 |
| 6,652,322 | B2 * | 11/2003 | Ito et al. | 439/637 |
| 6,672,875 | B1 * | 1/2004 | Mathieu et al. | 439/66 |
| 6,734,594 | B2 * | 5/2004 | Lee et al. | 310/220 |
| 7,168,990 | B2 * | 1/2007 | Suzuki et al. | 439/636 |

FOREIGN PATENT DOCUMENTS

| | | | |
|---|---|---|---|
| JP | 54-48009 | A | 4/1979 |
| JP | 55-120275 | U | 8/1980 |
| JP | 60-227378 | A | 11/1985 |
| JP | 64-081202 | A | 3/1989 |
| JP | 1-308146 | A | 12/1989 |
| JP | 2-99525 | U | 8/1990 |
| JP | 05-174934 | A | 7/1993 |
| JP | 05190241 | A | 7/1993 |
| JP | 09093877 | A | 4/1997 |
| JP | 2006-519467 | A | 8/2006 |

OTHER PUBLICATIONS

Korean Office Action issued Oct. 28, 2014 re: Korean Application No. 10-2013-0087802.
Japanese Office Action issued May 20, 2014 and English Translation Thereof, re: Japanese Application No. 2013-154846; pp. 12.
Korean Office Action (with English Translation) issued Apr. 29, 2014 re: Korean application No. 10-2013-0087802; 6 pp.

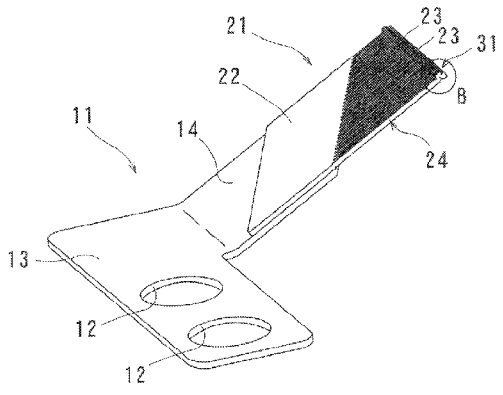
* cited by examiner

*Primary Examiner* — Tho D Ta
(74) *Attorney, Agent, or Firm* — Klarquist Sparkman, LLP

(57) **ABSTRACT**

An aspect of the present invention provides a brush in which positional accuracy of elastic contact pieces is enhanced while production cost is reduced by simplifying production, whereby the brush includes a support that is connected to a base and a conductive portion that is integral with the support, such that the conductive portion includes plural elastic contact pieces extending in parallel from a side edge of the support.

**18 Claims, 12 Drawing Sheets**



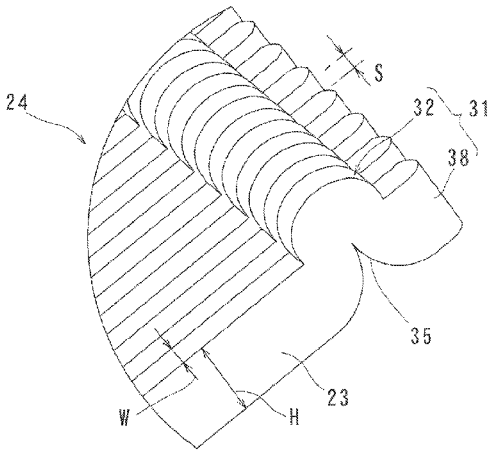



FIG. 1A

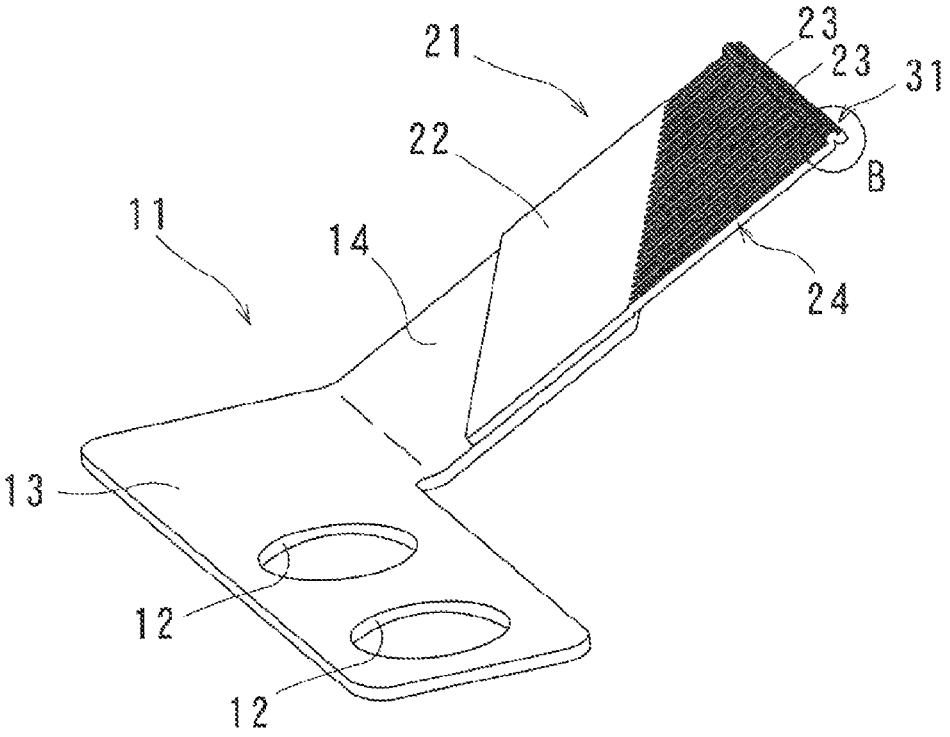



FIG. 1B

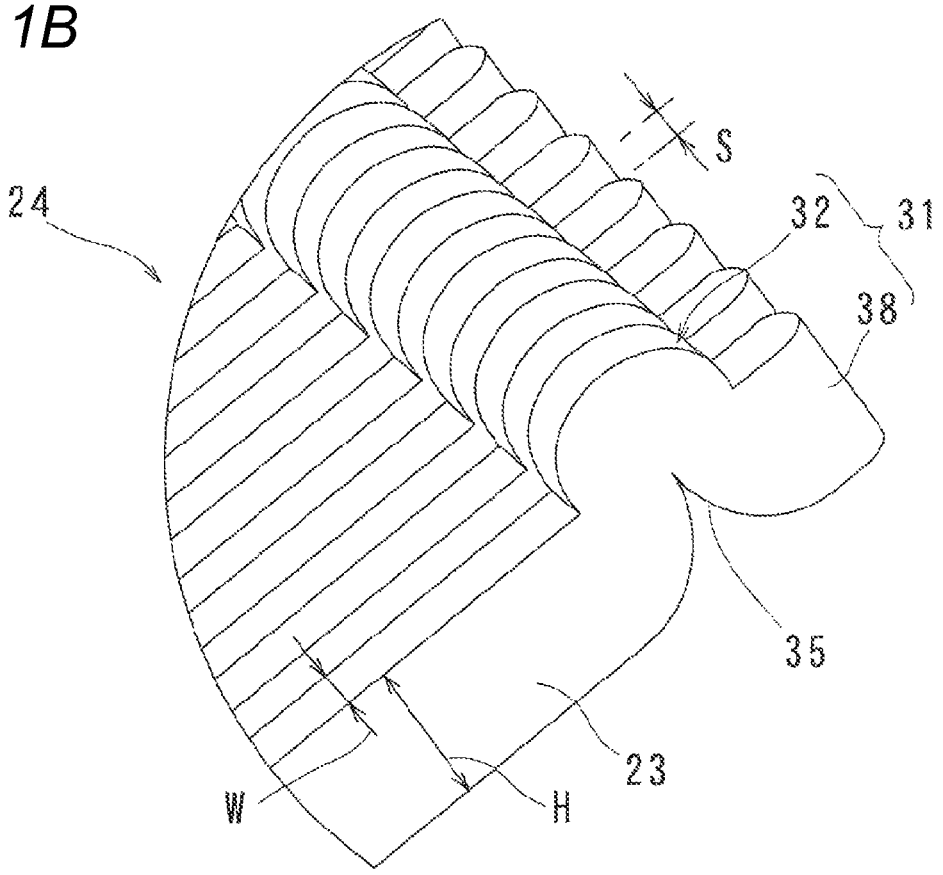


FIG. 2

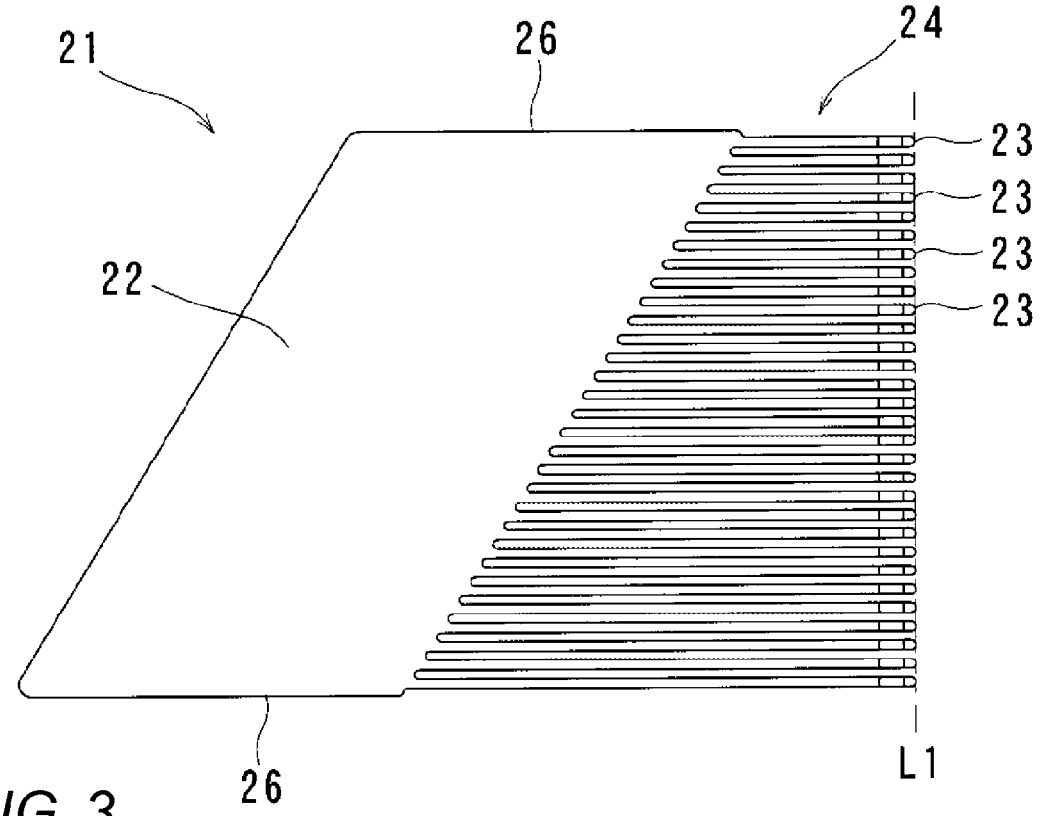



FIG. 3

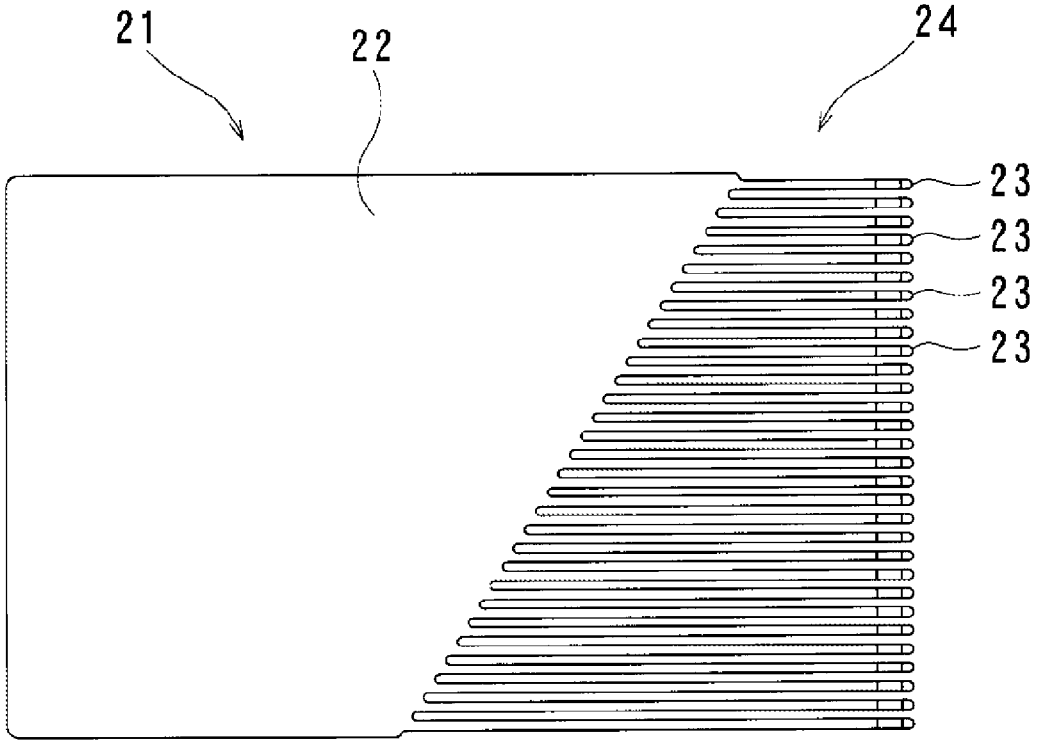


FIG. 4A

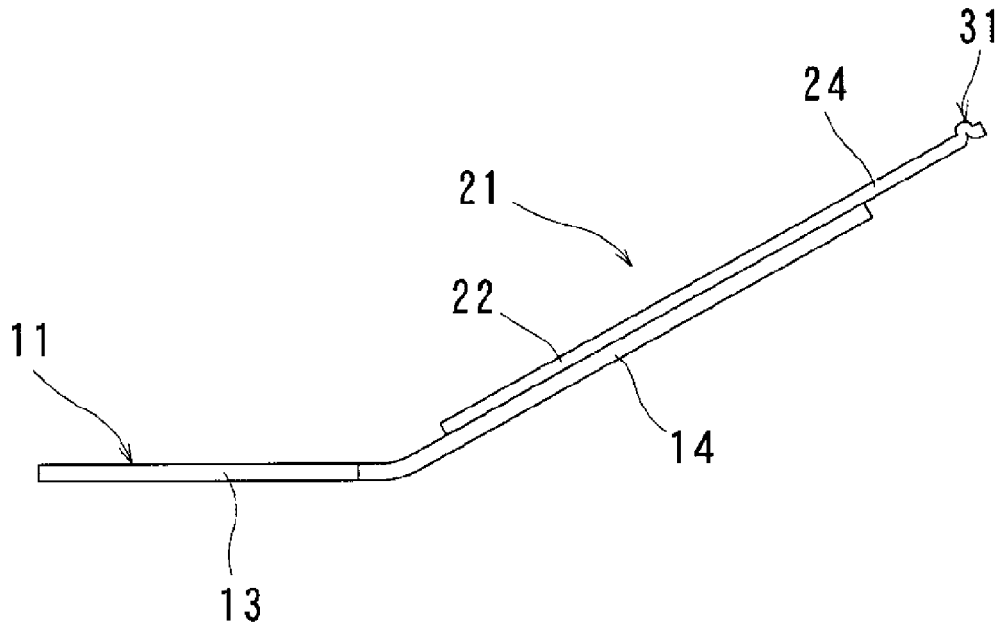
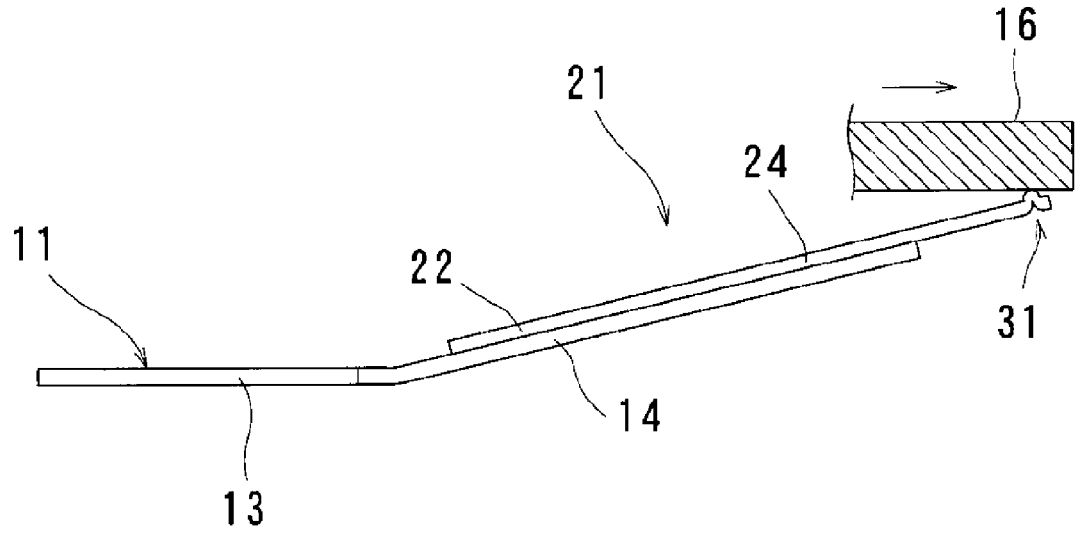



FIG. 4B




CONTACT FORCE OF EACH ELASTIC CONTACT PIECE
ELASTIC CONTACT PIECE NUMBER
CONTACT FORCE APPLIED TO EACH ELASTIC CONTACT PIECE/WHOLE CONTACT FORCE
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

FIG. 5A

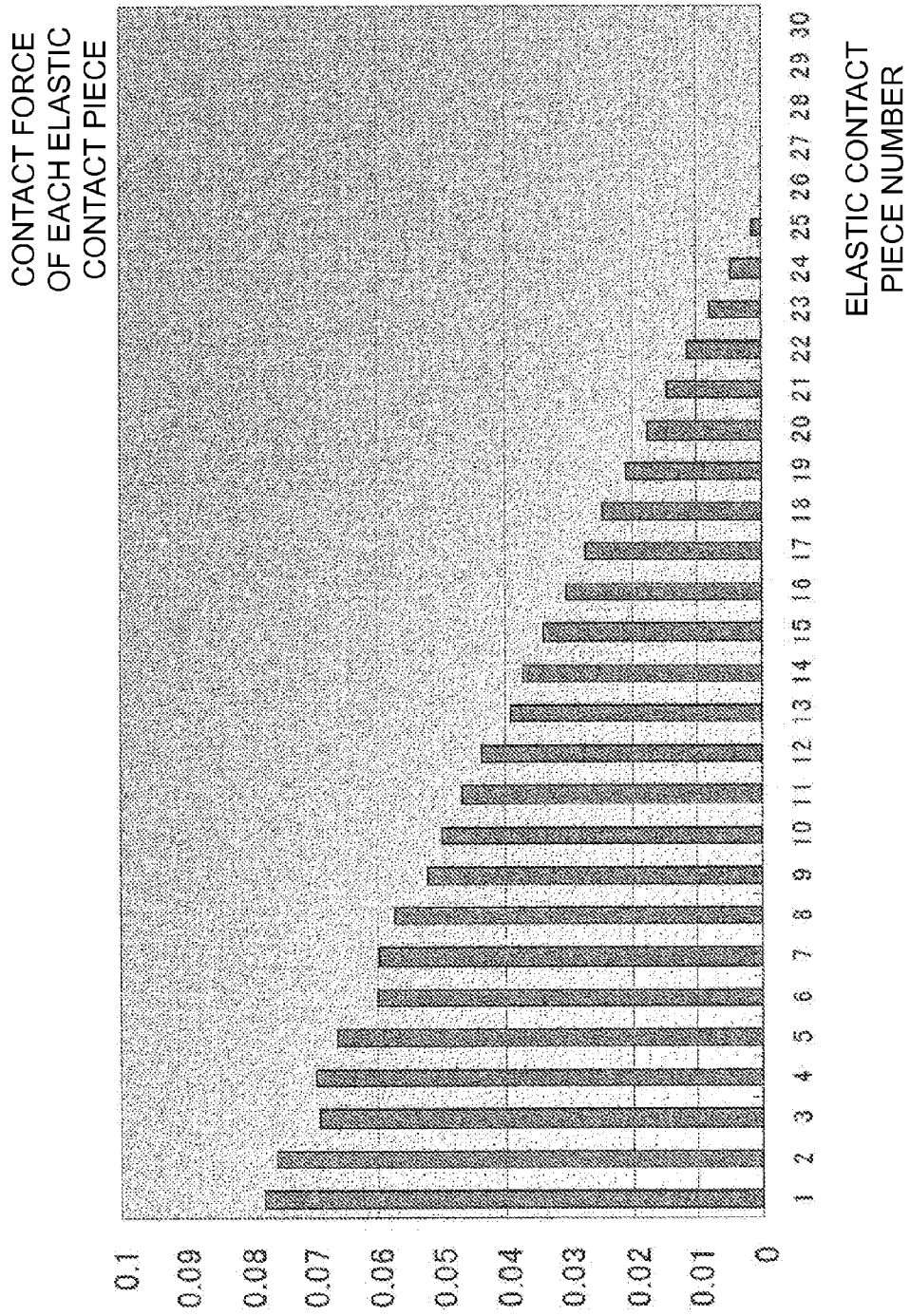

CONTACT FORCE OF EACH ELASTIC CONTACT PIECE
CONTACT FORCE APPLIED TO EACH ELASTIC CONTACT PIECE/WHOLE CONTACT FORCE
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
ELASTIC CONTACT PIECE NUMBER

FIG. 5B

FIG. 6A

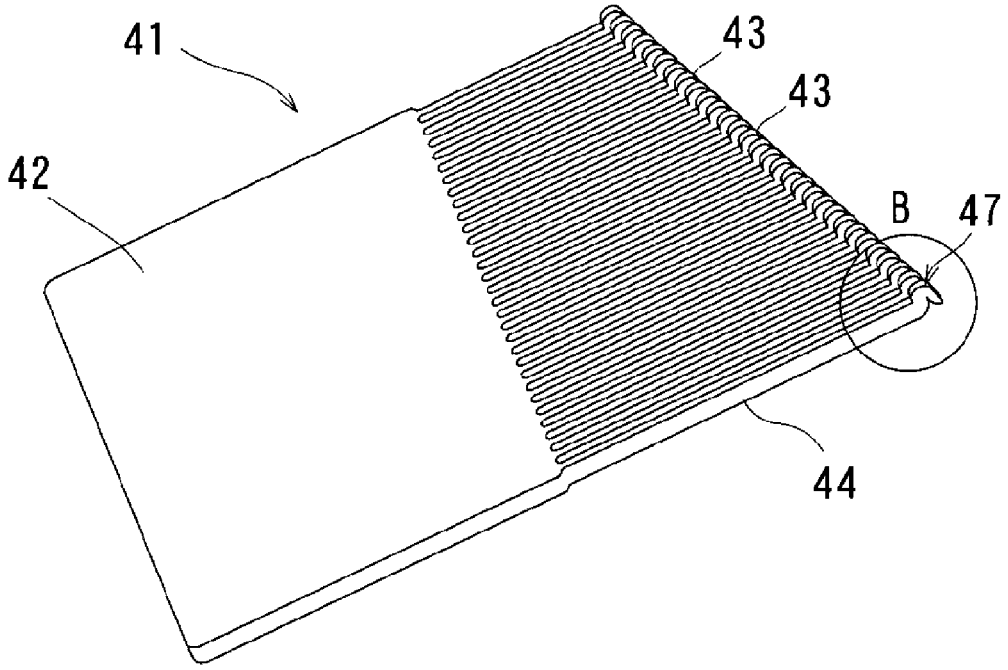



FIG. 6B

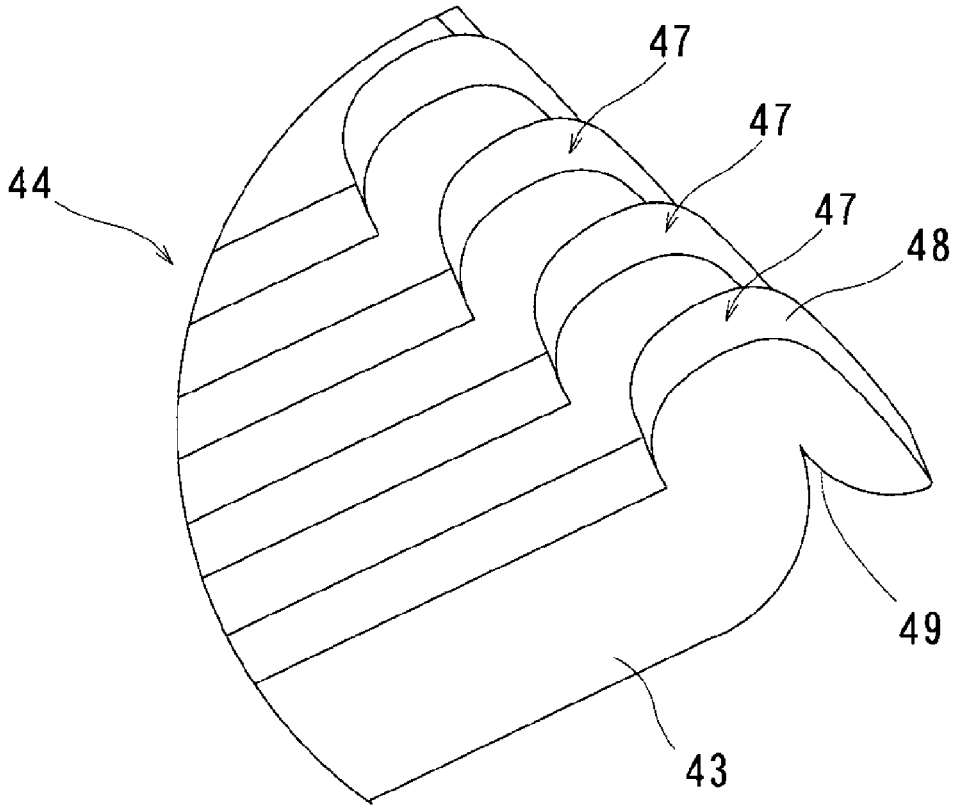


FIG. 7

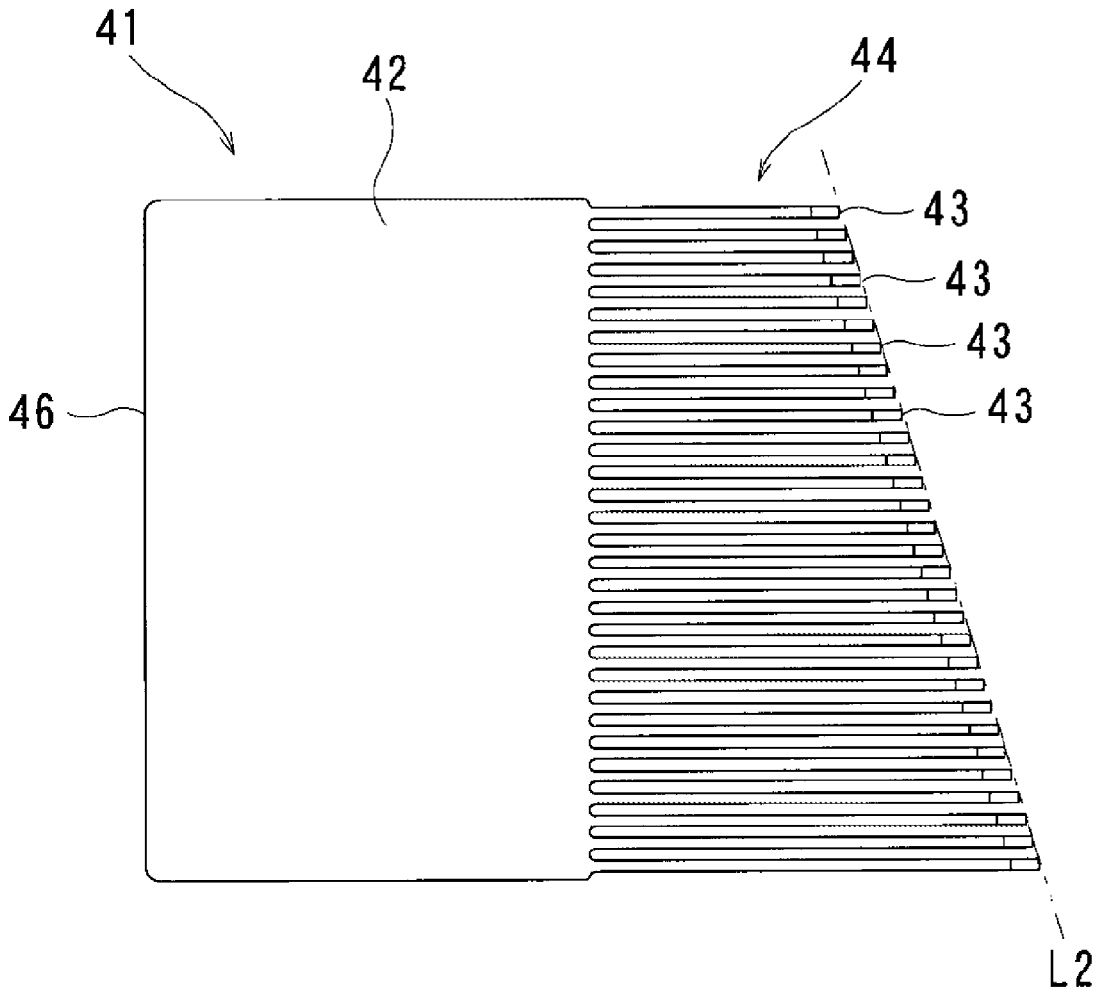


FIG. 8A

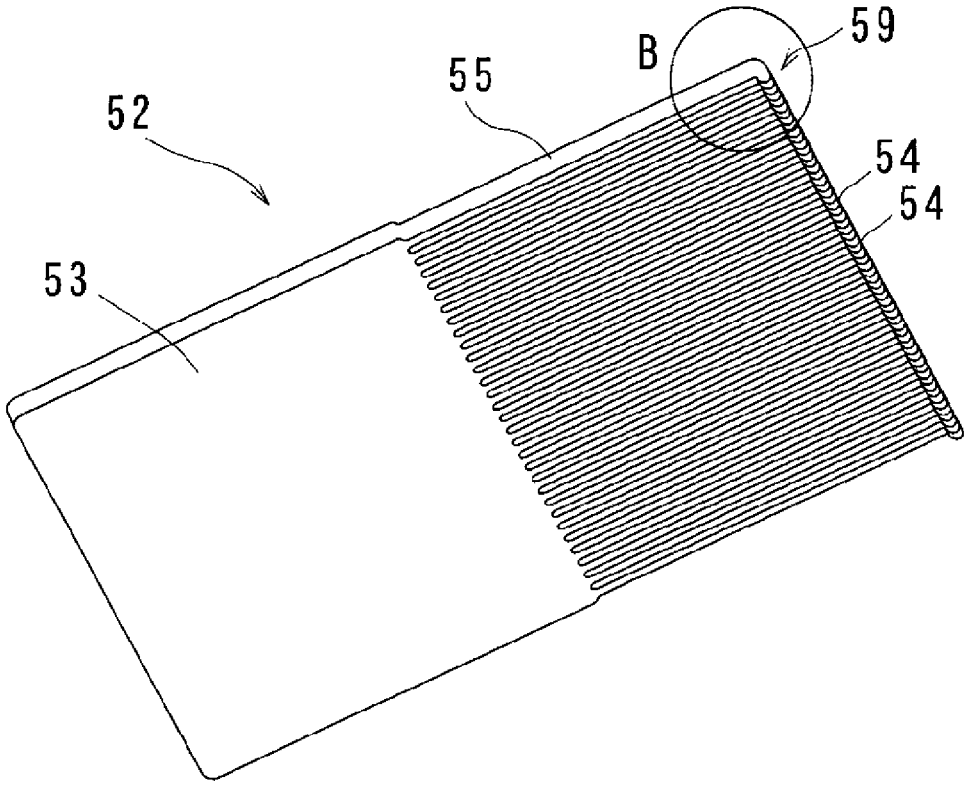



FIG. 8B

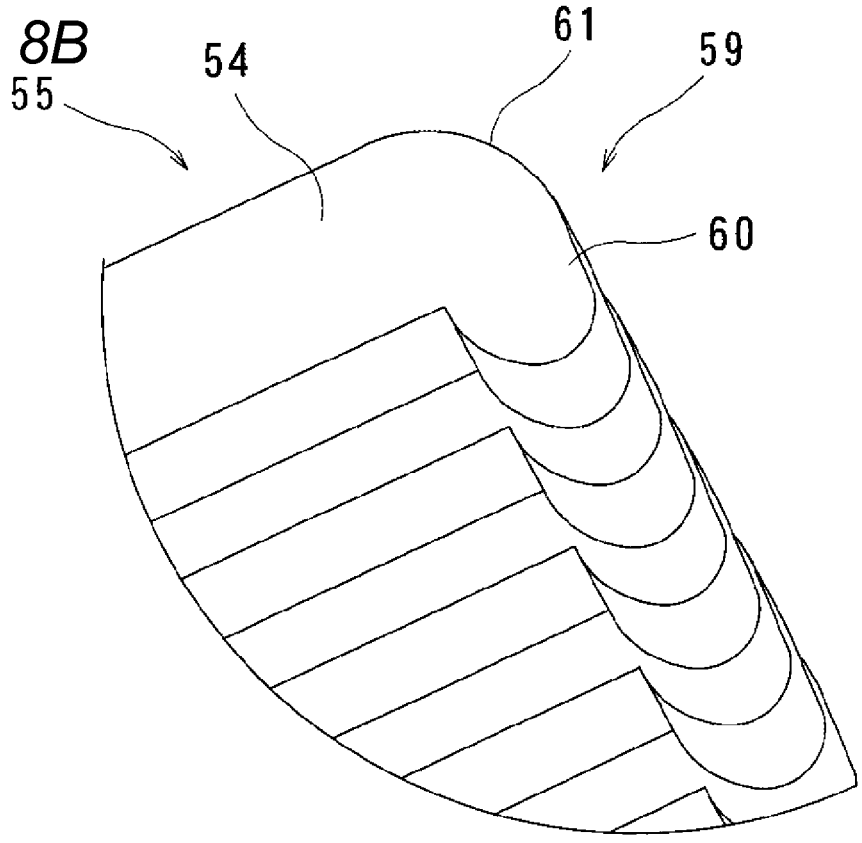


FIG. 9

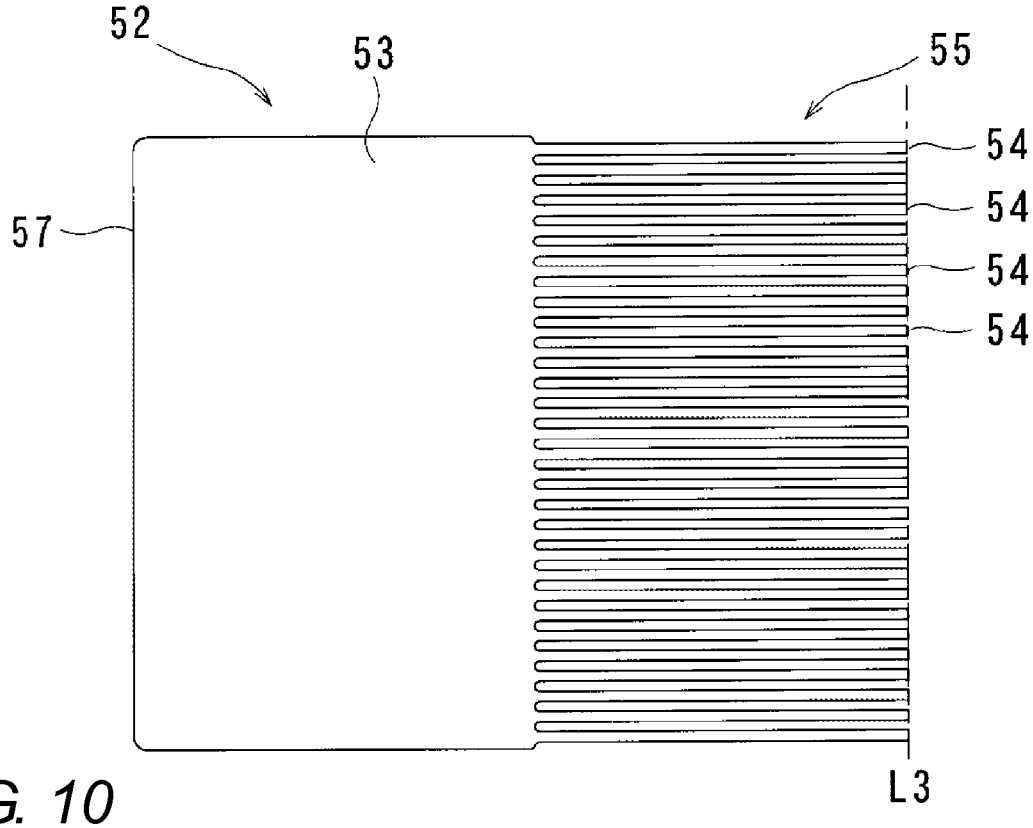



FIG. 10

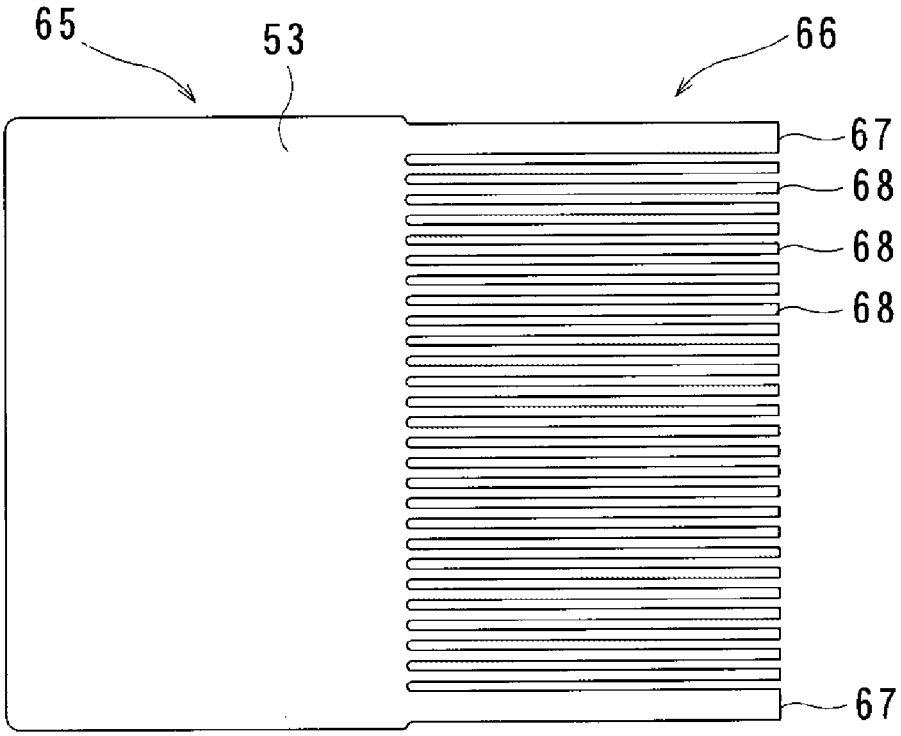


FIG. 11A

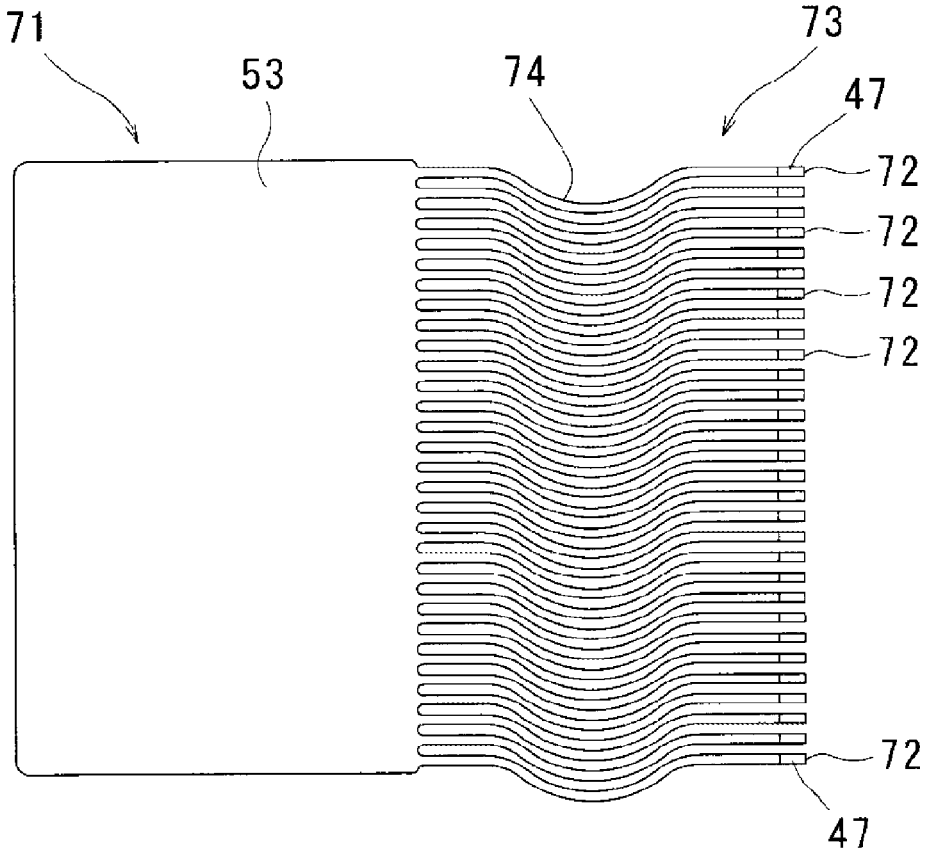



FIG. 11B

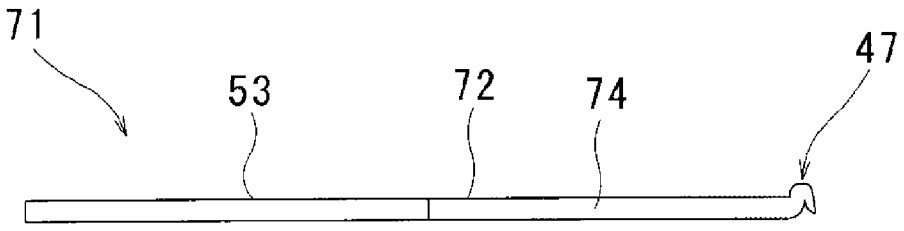


FIG. 12A

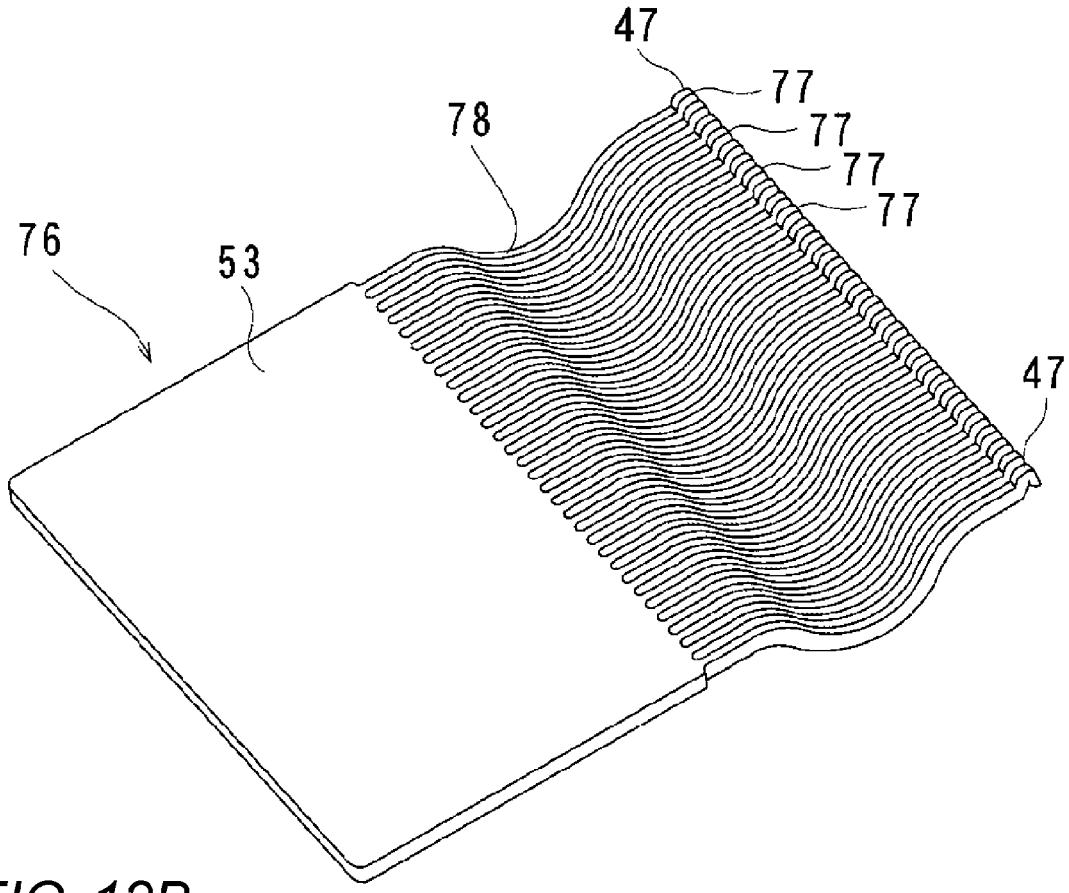



FIG. 12B

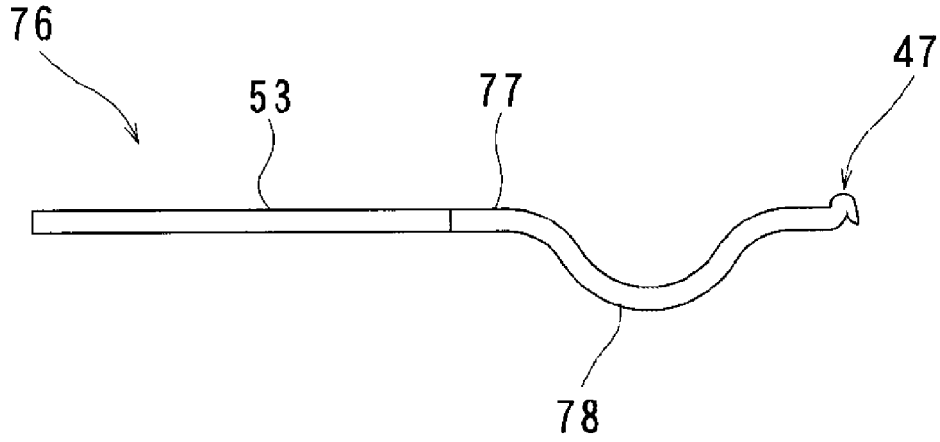


FIG. 13

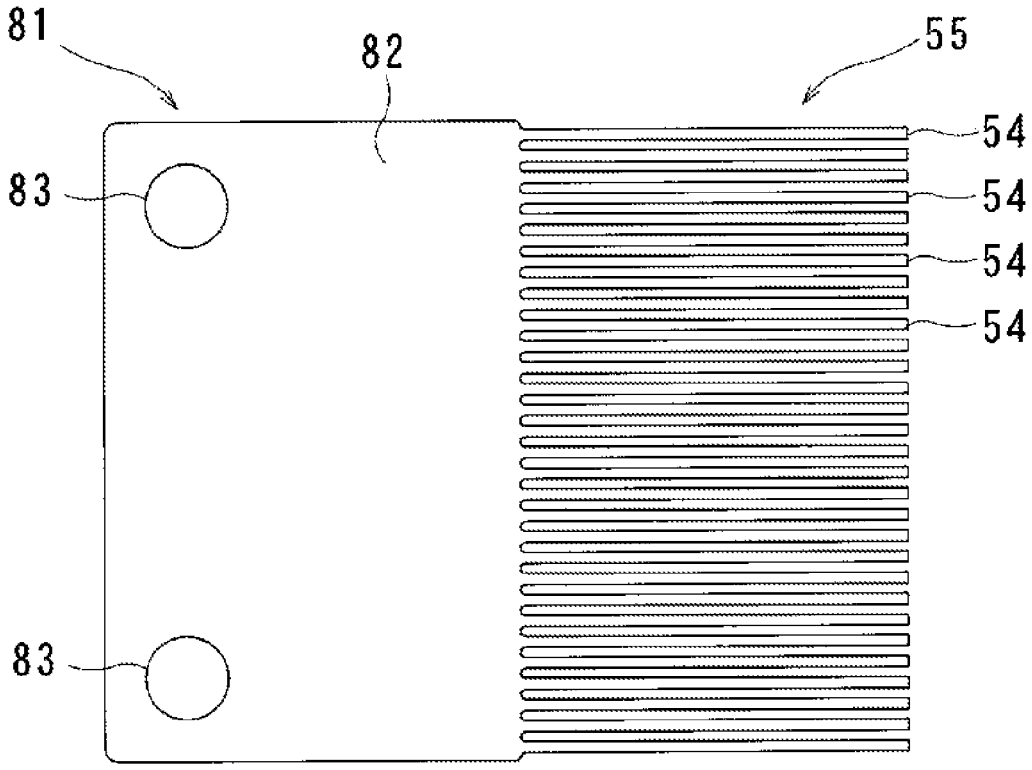
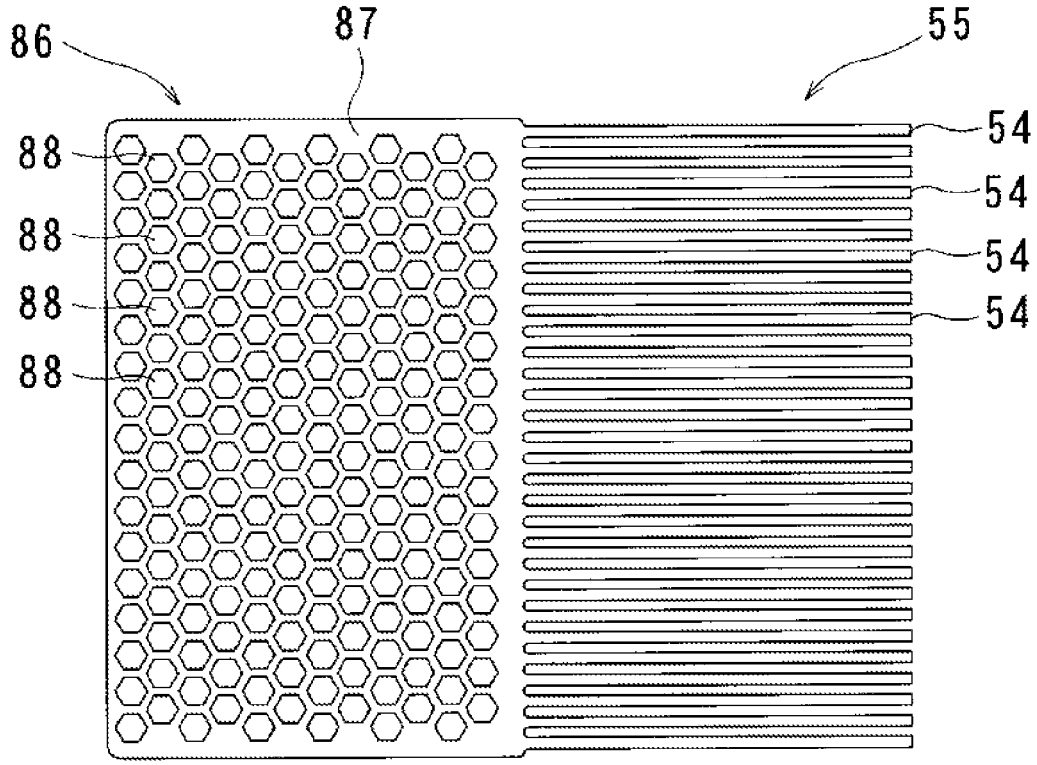



FIG. 14



# BRUSH HAVING A PLURALITY OF ELASTIC CONTACT PIECES ARRANGED IN PARALLEL

## CROSS REFERENCE TO RELATED APPLICATION

This application claims benefit of priority to Japanese Patent Application No. 2012-170554, filed on Jul. 31, 2012 of which the full contents are herein incorporated by reference.

## BACKGROUND OF THE INVENTION

The present invention relates to a brush. In particular, the present relates to a brush wherein plural elastic contact pieces are provided in parallel and are in contact with a conductive pattern placed in, for example, a rotating body in order to transmit an electric signal or an electric power between the rotating conductive pattern and the elastic contact pieces.

In accordance with a conventional configuration, a brush, as disclosed in Japanese Patent Publication No. 7-120563, consists of plural elastic contact pieces which are positioned and welded in parallel one by one to an edge portion of a support. Such a conventional configuration leads to a problem that it takes a lot of trouble with production of the brush, increases production cost, and a variation in positional accuracy of the elastic contact pieces is highly generated.

## SUMMARY OF THE INVENTION

Accordingly, the invention provides a brush which overcomes the above-mentioned problems and limitations of conventional art. Further, the invention provides a brush in which the positional accuracy of the elastic contact pieces is enhanced as well as the production cost is reduced by simplifying the production.

In accordance with one aspect of the present invention, there is provided a brush comprising: a support connected to a base; and a conductive portion configured to be integral with the support and having a plurality of elastic contact pieces. Further, the conductive portion extends in parallel from a side edge of the support.

According to the present invention, the simplification of the configuration of the brush enables the reduction of the production cost and the enhancement of a degree of design freedom. The support and the conductive portion are integrally formed, so that a high strength and a low profile can be implemented compared with the brush in which different components are joined to each other.

According to another embodiment of the present invention, a sliding portion may be provided at a leading end of the elastic contact pieces, wherein the sliding portion is electrically connected to an external conductor.

Preferably, each ratio of a width to a thickness of the elastic contact pieces may be from 1:4 to 1:1.5.

According to still another embodiment of the present invention, the plurality of elastic contact pieces comprising the elastic contact piece having a width different from another elastic contact piece.

According to yet another embodiment of the present invention the plurality of an elastic contact pieces comprises the elastic contact piece having a thickness different from another elastic contact piece.

According to one of the preferred embodiments of the present invention, a length of each of the plurality of the elastic contact pieces gradually increases from one side edge of the support to the other side of the support.



According to another embodiment of the present invention, in the conductive portion of the brush, a line is drawn along a leading end of the conductive portion and the line is inclined with respect to the side edge of the support.

Preferably, in the conductive portion, the elastic contact pieces located on both side edges of the conductive portion may be widened.

According to still another embodiment of the present invention, the conductive portion may be curved along a thickness direction.

According to still another embodiment of the present invention, the conductive portion may be curved along a width direction.

According to yet another embodiment of the present invention the sliding portion may include a reverse U-shape bulge.

According to one of the preferred embodiment of the present invention, the sliding portion may include a reverse U-shape bulge and a protrusion that extends outward from the bulge on a straight line identical to the elastic contact piece.

According to another embodiment of the present invention, the sliding portion may include a bulge that protrudes downward from a lower surface of the elastic contact piece and a curved surface that is continuous with an upper surface of the elastic contact piece which may be provided in a corner portion on an upper side of the bulge.

Preferably, the support may be a parallelogram.

Preferably, the support may be made up of porous material.

According to yet another embodiment of the present invention, the brush may be produced by electroforming.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention will become more readily appreciated and understood from the following detailed description of preferred embodiments of the invention when taken in conjunction with the accompanying drawings, in which:

FIG. **1**A is a perspective view of a state in which a brush according to a first embodiment of the present invention is fixed to a base;

FIG. **1**B is a partially enlarged perspective view of a B portion as shown in FIG. **1**A;

FIG. **2** is a plan view of the brush of the first embodiment of the present invention;

FIG. **3** is a plan view of a modification of the brush as shown in FIG. **2**;

FIG. **4**A is a side view of the base and the brush in FIG. **1** before actuation;

FIG. **4**B is a side view of an operating state of FIG. **4**A;

FIG. **5**A is a graph illustrating a result of an example in which a ratio of a contact force applied to each elastic contact piece to a contact force with a printed board, which is applied to a whole conductive portion;

FIG. **5**B is a graph illustrating a result of a comparative example in which a ratio of a contact force applied to each elastic contact piece to a contact force with the printed board, which is applied to the whole conductive portion wherein the elastic contact pieces having the same length;

FIG. **6**A is a perspective view of a brush according to a second embodiment of the present invention;

FIG. **6**B is a partially enlarged perspective view of a B portion as shown in FIG. **6**A;

FIG. **7** is a plan view of the brush as shown in FIGS. **6**A and **6**B;

FIG. **8**A is a perspective view of a brush according to a third embodiment of the present invention;

FIG. **8**B is a partially enlarged perspective view of a B portion as shown in FIG. **8**A;

FIG. **9** is a plan view of the brush as shown in FIGS. **8**A and **8**B;

FIG. **10** is a plan view of a brush according to a fourth embodiment of the present invention;

FIG. **11**A is a plan view of a brush according to a fifth embodiment of the present invention;

FIG. **11**B is a side view of the brush as shown in FIG. **11**A;

FIG. **12**A is a perspective view of a brush according to a sixth embodiment of the present invention;

FIG. **12**B is a side view of the brush as shown in FIG. **12**A;

FIG. **13** is a plan view of a brush according to a seventh embodiment of the present invention; and

FIG. **14** is a plan view of a brush according to an eighth embodiment of the present invention.

## DETAILED DESCRIPTION

The present invention is described hereinafter by various embodiments with reference to the accompanying drawings, wherein reference numerals used in the accompanying drawings correspond to the like elements throughout the description. Further, while discussing various embodiments, cross reference will made between the figures. In order to achieve full description and explanation, specific details have been mentioned to provide thorough and comprehensive understanding of various embodiments of the present invention. However, said embodiments may be utilized without such specific details and in various other ways broadly covered herein.

FIG. **1**A illustrates a brush **21** according to a first embodiment of the present invention. The brush **21** includes a parallelogram support **22** and a conductive portion **24**. The conductive portion **24** is constructed by plurality of elastic contact pieces **23** which are arranged in parallel on an edge portion of one side of the support **22**. Such a simplified configuration of the brush **21** enables reduction of production cost and enhancement of a degree of design freedom. Because the support **22** is parallelogram, usage of material for composing the support **22** is reduced while a welding region is ensured. Further, the support and the conductive portion are integrally formed, so that a high strength and a low profile can be implemented compared with the brush in which different components are joined to each other. Also, the usage of a material for composing the support is reduced while a connecting region is ensured.

A rear surface of the support **22** is welded to one end portion of a substantial plane L-shape base **11**. The base **11** includes a plate-like fixed portion **13** including a circular fixing through-hole **12** and a plate-like welded portion **14** extending obliquely upward from an edge of the fixed portion **13**.

The elastic contact pieces **23** and the support **22** are integrally formed by electroforming. Therefore, the brush **21** in which positional accuracy of the elastic contact pieces **23** is enhanced while the production cost is reduced by simplifying the production is obtained. The plurality of elastic contact pieces **23** extend from one of the end portions of the support **22** in parallel with opposed two sides **26** of the support **22**. In FIG. **2**, length of each of plurality of the elastic contact pieces **23** gradually increases while place from the side edge of the support **22** to the other side of the support **22**. On the other hand, a line L**1** drawn along leading ends of the conductive portion **24** is perpendicular to the sides **26**. As illustrated in FIG. **1**B, the elastic contact piece **23** has a rectangular section, and preferably an aspect ratio of a width W to a thickness H thereof from 1:4 to 1:1.5. When the aspect ratio is greater than 1:4, the elastic contact pieces **23** are weakened against a force from a horizontal direction generating torsion, and a necessary pressing force is not obtained. When the aspect ratio is smaller than 1:1.5, an interval between the elastic contact pieces **23** adjacent to each other is increased. The thickness is decreased with decreasing interval, and the necessary pressing force is not obtained. More specifically, for example, in the case where the thickness H of the elastic contact pieces **23** is set to a range of 80 μm to 150 μm in order to satisfy the aspect ratio of 1:1.5, the width W is set to 100 μm or less. The elastic contact piece **23** is not limited to the rectangular section, but that the elastic contact piece **23** may have a semicircular section, for example. The width W and the thickness H are not limited to the mentioned specific numerical values, but of course, the width W and the thickness H may be arbitrarily set. Therefore, a contact pressure necessary to ensure the conduction can be obtained between sliding portions **31** and a printed board **16**, while rigidity of the elastic contact pieces **23** are ensured. Each width W of the elastic contact pieces **23** may vary. Specifically, for example, the one elastic contact piece **23** may have a trapezoidal shape in planar view. It may be configured that among the elastic contact pieces **23** adjacent to each other, one of the elastic contact pieces **23** may have the width W less than that of the other elastic contact piece **23**. Similarly, each thickness H of the elastic contact pieces **23** may vary.

Therefore, even if torsion is generated about an axis in a length direction of the brush, the contact force between each elastic contact piece and the printed board can homogeneously be maintained. That is, a difference in the contact forces applied to each elastic contact piece is eliminated by homogenizing a spring force of the elastic contact piece on one side and a spring force of the elastic contact piece on the other side, so as to ensure contact reliability and durability. Further, rigidity of the elastic contact pieces can be enhanced to obtain the desired contact pressure between the sliding portions and the printed board.

The sliding portion **31** that is in contact with, for example a printed board **16** (see FIG. **4**B) is formed in a leading end portion of each elastic contact piece **23**. Therefore, an inter-support-point distance between the support **22** and the sliding portions **31** is arbitrarily set by changing a length of the elastic contact pieces **23**, and the desired contact pressure can be obtained between the sliding portions **31** and the printed board **16**. As illustrated in FIG. **1**B, the sliding portion **31** includes a reverse U-shape bulge **32** and a protrusion **38** that extends outward from the bulge **32** on a straight line identical to the elastic contact piece **23**. An upper portion of the bulge **32** protrudes upward from an upper surface of the elastic contact piece **23**, and a section of the bulge **32** is formed into a semicircular shape. A reverse V-shape groove **35** is formed upward in the lower portion of the bulge **32**.

In the present embodiment, the support **22** is formed into the parallelogram shape, but is not limited thereto. Alternatively, for example, a trapezoidal support **22** may be used as illustrated in FIG. **3**.

As illustrated in FIG. **4**A, the brush **21** is welded to the base **11** and inclined with respect to the fixed portion **13**. As illustrated in FIG. **4**B, when the printed board **16** comes into contact with the sliding portions **31**, the brush **21** is biased in an arrow direction together with the welded portion **14** of the base **11** and therefore the brush **21** falls. At this point, the sliding portions **31** are always in contact with the printed board **16** at a predetermined contact pressure by an elastic force of the base **11**.

Particularly, in the brush **21** of the present embodiment, each length of the elastic contact pieces **23** is gradually increased from the elastic contact piece **23** on one side toward

the elastic contact piece **23** on the other side. For this reason, when the printed board **16** presses and displaces the sliding portions **31**, the contact force between each elastic contact piece **23** and the printed board **16** can homogeneously be maintained even if a clockwise torsion moment acts on the brush **21** about a lengthwise-direction axis. That is, a difference in the contact forces generated in each elastic contact piece **23** is eliminated by homogenizing a spring force of the elastic contact piece **23** on one side and a spring force of the elastic contact piece **23** on the other side, so as to ensure contact reliability and durability. FIG. **5**A illustrates a result of an example in which a ratio of the contact force applied to each elastic contact piece **23** to the contact force with the printed board **16**, which is applied to the whole conductive portion **24**. FIG. **5**B illustrates a result of a comparative example in which a ratio of the contact force applied to each elastic contact piece to the contact force with the printed board, which is applied to the whole conductive portion including the elastic contact pieces having the same length. Therefore, it is confirmed that the contact forces applied to each elastic contact piece vary in the comparative example, whereas in the conductive portion **24** of the present embodiment, the contact force is homogeneously applied to each elastic contact piece **23**.

As illustrated in FIG. **6**A, a brush **41** according to a second embodiment of the present invention includes a rectangular support **42** (see FIG. **7**) and a conductive portion **44** including the plurality of elastic contact pieces **43**.

A line L**2** drawn along the leading ends of the plurality of elastic contact pieces **43** is inclined with respect to a long side **46** of the support **42**. As illustrated in FIG. **6**B, a sliding portion **47** is formed in the leading end portion of each elastic contact piece **43**. The sliding portion **47** includes only a reverse U-shape bulge **48** each of which is continuous with the elastic contact piece **43**. The upper portion of the bulge **48** protrudes upward from the upper surface of the elastic contact piece **43**, and the section of the bulge **48** is formed into the semicircular shape. A reverse V-shape groove **49** is formed upward in the lower portion of the bulge **48**.

As illustrated in FIG. **8**A, a brush **52** according to a third embodiment of the present invention includes a rectangular support **53** (see FIG. **9**) and a conductive portion **55** including plurality of elastic contact pieces **54**.

A line L**3** drawn along the leading ends of the plurality of elastic contact pieces **54** is parallel to a long side **57** of the support **53**. As illustrated in FIG. **8**B, a sliding portion **59** is formed in the leading end portion of each elastic contact piece **54**. The sliding portion **59** includes a bulge **60** that protrudes downward from the lower surface of the elastic contact piece **54**. A curved surface **61** that is continuous with the upper surface of the elastic contact piece **54** is formed in a corner portion on the upper side of the bulge **60**, and the printed board **16** is in contact with the curved surface **61**. A lower end of the bulge **60** has a semicircular section.

In the embodiments, the width is homogeneously formed in all the elastic contact pieces, but is not limited thereto. For example, as in a brush **65** according to a fourth embodiment illustrated in FIG. **10**, widths of elastic contact pieces **67** located on both sides of a conductive portion **66** may be made greater than those of other elastic contact pieces **68**. Therefore, even if an external force is applied from a lateral side of the conductive portion **66**, the high-strength, widened elastic contact piece **67** counteracts the external force, so that damage on the conductive portion **66** can be prevented. Since the other configurations are identical to those of the third embodiment, the identical component is designated by the identical numeral, and the description thereof is omitted. Therefore, even if an external force is laterally applied to the conductive portion, the high-strength, widened elastic contact pieces counteract the external force, so that damage on the conductive portion can be prevented.

In the embodiments, the description is made on the case where the elastic contact piece is linearly formed, but is not limited thereto. For example, as illustrated in FIGS. **11**A and **11**B, in a brush **71** according to a fifth embodiment, a curved portion **74** that is curved in a width direction on the same surface as a conductive portion **73** is formed in a center of an elastic contact piece **72**. As another example, as illustrated in FIG. **12**A, a curved portion **78** that is curved downward in a thickness direction is formed in the center of an elastic contact piece **77** of a brush **76** according to a sixth embodiment (see FIG. **12**(B)). The inter-support-point distance between a side edge on the side of the sliding portions **47** of the support **53** and the sliding portions **47** is lengthened by providing the curved portions **74** and **48**, and a fatigue breaking is hardly occurred. Therefore, the durability of the brush **71** and **76** is enhanced. Therefore, because the inter-support-point distance is lengthened, a fatigue breaking is hardly occurred, and the durability of the conductive portion is enhanced.

As in a brush **81** according to a seventh embodiment illustrated in FIG. **13**, a circular positioning through-hole **83** may be made at a corner of a support **82**. The brush **81** is positioned using the positioning through-hole **83**, which allows the high-accurate brush **81** to be produced. Similarly, as in a brush **86** according to an eighth embodiment illustrated in FIG. **14**, many hexagonal through-holes **88** may be made in a support **87**. Therefore, advantageously the brush **86** can be reduced in weight while the usage of the material for composing the support **87** is reduced.

The brush according to the first to eighth embodiments are described above. However, for example, such as applying the sliding portions **47** of the second embodiment to the brush **21** of the first embodiment, the support, the elastic contact pieces, the conductive portion, and the sliding portions described in each embodiment can be combined for different purposes to form the brush.

Preferably, the support may be made up of porous material. Therefore, advantageously the brush assembly can be reduced in weight while the usage of the material for forming the support is reduced.

There has thus been shown and described a connecting terminal and a connector which fulfills all the objects and advantages sought therefore. Many changes, modifications, variations and other uses and applications of the subject invention will, however, become apparent to those skilled in the art after considering this specification and the accompanying drawings which disclose the preferred embodiments thereof. All such changes, modifications, variations and other uses and applications which do not depart from the spirit and scope of the invention are deemed to be covered by the invention, which is to be limited only by the claims which follow.

Although the invention has been described in detail for the purpose of illustration based on what is currently considered to be the most practical and preferred embodiments, it is to be understood that such detail is solely for that purpose and that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover modifications and equivalent arrangements that are within the spirit and scope of the appended claims. For example, it is to be understood that the present invention contemplates that, to the extent possible, one or more features of any embodiment can be combined with one or more features of any other embodiment.

What is claimed is:

1. An electrical brush comprising:

a support connected to a base;

a conductive portion configured to be integral with the support and having a plurality of elastic contact pieces;

wherein the conductive portion extends in parallel from a side edge of the support, and a length of each of the plurality of elastic contact pieces gradually increases from one side edge of the support to another side of the support.

2. The electrical brush according to claim 1, wherein each aspect ratio of a width to a thickness of the elastic contact pieces is from 1:4 to 1:1.5.

3. The electrical brush according to claim 1, wherein the plurality of elastic contact pieces comprises the elastic contact piece having a width different from another elastic contact piece.

4. The electrical brush according to claim 1, wherein the plurality of elastic contact pieces comprises the elastic contact piece having a thickness different from another elastic contact piece.

5. The electrical brush according to claim 1, wherein in the conductive portion of the electrical brush, a line is drawn along a leading end of the conductive portion and the line is inclined with respect to the side edge of the support.

6. The electrical brush according to claim 1, wherein a first of the elastic contact pieces is located at a first side edge of the conductive portion and a second of the elastic contact pieces is located at a second opposite edge of the conductive portion, and wherein the first and second elastic contact pieces each have a width greater than a width of the remaining elastic contact pieces which are disposed between the first and second elastic contact pieces.

7. The electrical brush according to claim 1, wherein the conductive portion is curved along a thickness direction.

8. The electrical brush according to claim 1, wherein the conductive portion is curved along a width direction.

9. The electrical brush according to claim 1, wherein the support is a parallelogram.

10. The electrical brush according to claim 1, wherein the support is made of porous material.

11. The electrical brush according to claim 1, wherein the electrical brush is produced by electroforming.

12. The electrical brush according to claim 1, further comprising a sliding portion provided at a leading end of the elastic contact pieces, wherein the sliding portion is electrically connected to an external conductor.

13. The electrical brush according to claim 12, wherein each aspect ratio of a width to a thickness of the elastic contact pieces is from 1:4 to 1:1.5.

14. The electrical brush according to claim 12, wherein the sliding portion includes a reverse U-shape bulge.

15. The electrical brush according to claim 12, wherein the sliding portion includes a reverse U-shape bulge and a protrusion that extends outward from the bulge on a straight line identical to the elastic contact piece.

16. The electrical brush according to claim 12, wherein the sliding portion includes a bulge that protrudes downward from a lower surface of the elastic contact piece and a curved surface that is continuous with an upper surface of the elastic contact piece is provided in a corner portion on an upper side of the bulge.

17. An electrical brush comprising:

a support connected to a base;

a conductive portion configured to be integral with the support and having a plurality of elastic contact pieces;

wherein the conductive portion extends in parallel from a side edge of the support; and

wherein in the conductive portion of the electrical brush, a line is drawn along a leading end of the conductive portion and the line is inclined with respect to the side edge of the support.

18. An electrical brush comprising:

a support connected to a base;

a conductive portion configured to be integral with the support and having a plurality of elastic contact pieces;

wherein the conductive portion extends in parallel from a side edge of the support; and

wherein a first of the elastic contact pieces is located at a first side edge of the conductive portion and a second of the elastic contact pieces is located at a second opposite edge of the conductive portion, and wherein the first and second elastic contact pieces each have a width greater than a width of the remaining elastic contact pieces which are disposed between the first and second elastic contact pieces.

* * * * *